Document made available under the Patent Cooperation Treaty (PCT)

International application number: PCT/US05/035550

International filing date: 03 October 2005 (03.10.2005)

Document type: Certified copy of priority document

Document details: Country/Office: US
Number: 10/956,660
Filing date: 01 October 2004 (01.10.2004)

Date of receipt at the International Bureau: 16 November 2005 (16.11.2005)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b)

World Intellectual Property Organization (WIPO) - Geneva, Switzerland
Organisation Mondiale de la Propriété Intellectuelle (OMPI) - Genève, Suisse

1393585

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

November 15, 2005

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A FILING DATE.

APPLICATION NUMBER: *10/956,660*
FILING DATE: *October 01, 2004*
RELATED PCT APPLICATION NUMBER: *PCT/US05/35550*

THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS CONVENTION, IS *US10/956,660*

UNITED STATES PATENT AND TRADEMARK OFFICE · DEPARTMENT OF COMMERCE

Certified by

Jon W. Dudas

Under Secretary of Commerce
for Intellectual Property
and Director of the United States
Patent and Trademark Office

PTO/SB/05 (09-04)
Approved for use through 07/31/2006. OMB 0651-0032
U.S. Patent and Trademark Office.U .S. DEPARTMENT OF COMMERCE

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	0876-0173
First Inventor	Jeffrey P. Schroen et al.
Title	Nitrogen Sparging of Citrus Juice
Express Mail Label No.	EL613567799US

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. ☑ **Fee Transmittal Form** (e.g., PTO/SB/17)
   (Submit an original and a duplicate for fee processing)
2. ☐ **Applicant claims small entity status.**
   See 37 CFR 1.27.
3. ☑ **Specification** [*Total Pages* 10]
   Both the claims and abstract must start on a new page
   (For information on the preferred arrangement, see MPEP 608.01(a))
4. ☑ **Drawing(s)** (*35 U.S.C. 113*) [*Total Sheets* 1]
5. **Oath or Declaration** [*Total Sheets* 2]
   a. ☑ Newly executed (original or copy)
   b. ☐ A copy from a prior application (37 CFR 1.63(d))
   (for continuation/divisional with Box 18 completed)
   i. ☐ DELETION OF INVENTOR(S)
   Signed statement attached deleting inventor(s) name in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
6. ☐ **Application Data Sheet.** See 37 CFR 1.76
7. ☐ **CD-ROM or CD-R** in duplicate, large table or Computer Program *(Appendix)*
   ☐ Landscape Table on CD
8. **Nucleotide and/or Amino Acid Sequence Submission**
   (if applicable, items a. – c. are required)
   a. ☐ Computer Readable Form (CRF)
   b. Specification Sequence Listing on:
      i. ☐ CD-ROM or CD-R (2 copies); or
      ii. ☐ Paper
   c. ☐ Statements verifying identity of above copies

ADDRESS TO:

Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

ACCOMPANYING APPLICATION PARTS

9. ☑ **Assignment Papers** (cover sheet & document(s))
   Name of Assignee Tropicana Products, Inc.
10. ☐ **37 CFR 3.73(b) Statement** *(when there is an assignee)* ☐ **Power of Attorney**
11. ☐ **English Translation Document** *(if applicable)*
12. ☑ **Information Disclosure Statement** (PTO/SB/08 or PTO-1449)
    ☑ Copies of citations attached
13. ☐ **Preliminary Amendment**
14. ☑ **Return Receipt Postcard** (MPEP 503)
    (Should be specifically itemized)
15. ☐ **Certified Copy of Priority Document(s)**
    (if foreign priority is claimed)
16. ☐ **Nonpublication Request** under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent.
17. ☐ Other:

18. If a CONTINUING APPLICATION, *check appropriate box, and supply the requisite information below and in the first sentence of the specification following the title, or in an Application Data Sheet under 37 CFR 1.76:*

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application No.: .....

Prior application information: *Examiner* _____ *Art Unit:* _____

19. CORRESPONDENCE ADDRESS

☑ The address associated with Customer Number: 000026568 *OR* ☐ Correspondence address below

Name					
Address					
City		State		Zip Code	
Country		Telephone		Fax	

Signature		Date	10/1/04
Name (Print/Type)	Daniel M. Riess	Registration No. (Attorney/Agent)	24,375

22713 U.S.PTO
100104

PTO/SB/17 (10-04)
Approved for use through 07/31/2006. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

FEE TRANSMITTAL for FY 2005

Effective 10/01/2004. Patent fees are subject to annual revision.

☐ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT	($) 830.00

Complete if Known	
Application Number	
Filing Date	
First Named Inventor	Jeffrey P. Schroen et al.
Examiner Name	
Art Unit	
Attorney Docket No.	

METHOD OF PAYMENT *(check all that apply)*

☑ Check ☐ Credit card ☐ Money Order ☐ Other ☐ None

☑ Deposit Account:

Deposit Account Number: 50/1039

Deposit Account Name: Cook, Alex, McFarron, Manzo, Cummings & Mehler, Ltd

The Director is authorized to: *(check all that apply)*

☐ Charge fee(s) indicated below ☑ Credit any overpayments

☑ Charge any additional fee(s) or any underpayment of fee(s)

☐ Charge fee(s) indicated below, except for the filing fee to the above-identified deposit account.

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1001	7X0	2001	3X5	Utility filing fee	790.00
1002	3T0	2002	175	Design filing fee	
1003	5T0	2003	2R5	Plant filing fee	
1004	7X0	2004	3X5	Reissue filing fee	
1005	160	2005	80	Provisional filing fee	

SUBTOTAL (1) ($) 790.00

2. EXTRA CLAIM FEES FOR UTILITY AND REISSUE

	Extra Claims		Fee from below	Fee Paid
Total Claims 14	-20** = 0	X		= 0
Independent Claims 2	- 3** = 0	X		= 0
Multiple Dependent				= 0

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
1202	18	2202	9	Claims in excess of 20
1201	82	2201	4.	Independent claims in excess of 3
1203	E0	2203	150	Multiple dependent claim, if not paid
1204	82	2204	4.	** Reissue independent claims over original patent
1205	18	2205	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($) 0

**or number previously paid, if greater; For Reissues, see above

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1051	130	2051	65	Surcharge - late filing fee or oath	
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet	
1053	130	1053	130	Non-English specification	
1812	2,520	1812	2,520	For filing a request for *ex parte* reexamination	
1804	920*	1804	920*	Requesting publication of SIR prior to Examiner action	
1805	1,840*	1805	1,840*	Requesting publication of SIR after Examiner action	
1251	110	2251	55	Extension for reply within first month	
1252	4 0	2252	215	Extension for reply within second month	
1253	920	2253	4XE	Extension for reply within third month	
1254	1,T 0	2254	7AT	Extension for reply within fourth month	
1255	2,080	2255	1,040	Extension for reply within fifth month	
1401	340	2401	170	Notice of Appeal	
1402	340	2402	170	Filing a brief in support of an appeal	
1403	300	2403	150	Request for oral hearing	
1451	1,510	1451	1,510	Petition to institute a public use proceeding	
1452	110	2452	55	Petition to revive - unavoidable	
1453	1,330	2453	665	Petition to revive - unintentional	
1501	1,370	2501	685	Utility issue fee (or reissue)	
1502	490	2502	245	Design issue fee	
1503	660	2503	330	Planti ssue fee	
1460	130	1460	130	Petitions to the Commissioner	
1807	50	1807	50	Processing fee under 37 CFR 1.17(q)	
1806	180	1806	180	Submission of Information Disclosure Stmt	
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	40.00
1809	7X0	2809	3X5	Filing a submission after final rejection (37 CFR 1.129(a))	
1810	790	2810	3X5	For each additional invention to be examined (37 CFR 1.129(b))	
1801	7X0	2801	3X5	Request for Continued Examination (RCE)	
1802	900	1802	900	Request for expedited examination of a design application	

Other fee (specify) _____

*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) ($) 40.00

SUBMITTED BY

(Complete *(if applicable)*)

Name (Print/Type)	Daniel M. Ries	Registration No. (Attorney/Agent)	24/375	Telephone	312-236-8500
Signature				Date	10/11/04

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

This collection of information is required by 37 CFR 1.17 and 1.27. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

NITROGEN SPARGING OF CITRUS JUICE

Jeffrey P. Schroen
Bryan W. Hitchcock
Yongsoo Chung

Background and Summary of the Invention

[0001] The present invention is directed to a system for and method of sparging citrus juice with nitrogen gas.

[0002] Citrus juices, such as orange, grapefruit, lemon and lime, which are being processed for packaging and/or storage frequently contain dissolved oxygen and volatile compounds which have off flavor notes. It is desirable to remove as much as possible of the dissolved oxygen because it tends to enter into undesirable oxidation reactions with the citrus components which can reduce the flavor or sensory qualities of the juice particularly over extended periods of shelf storage. And of course it is desirable to remove to the extent possible any volatile compounds from the juice which might otherwise reduce the flavor and/or sensory qualities of the juice.

[0003] For these reasons, the processing of citrus juices for packaging and/or storage to date has resorted to vacuum procedures to remove dissolved oxygen and to the extent possible volatile compounds having off-notes. However, these vacuum procedures are relatively inefficient, require considerable capital expenditures for the vacuum equipment and consume large production areas of space which might otherwise be devoted to other more productive uses. Moreover, where it is desired to reduce dissolved oxygen to as low as 0.5ppm, it has generally been necessary to heat the citrus juice during vacuum treatment to temperatures of 85-145°F for 3-4 minutes. This not only results in increased energy consumption, but also produces some measure of thermal degradation of the citrus juice which itself produces oxidative degradation, enzymatic and non-enzymatic browning and off-notes.

[0004] In the present invention, it has been discovered that when a citrus juice is sparged with nitrogen gas at least at one or preferably more than one location during the processing of the citrus juice for packaging and/or storage and without subjecting the juice to vacuum, the dissolved oxygen content may be significantly reduced from levels

on the order of 5ppm to levels of less than 0.03ppm, and in some cases as little as 0.002ppm. Moreover, this result is possible at temperatures as low as 35°F and without the need to extensively heat the citrus juice as was necessary in the prior vacuum procedures if it was desired to obtain low levels of dissolved oxygen. The low levels of dissolved oxygen which are made possible by the nitrogen sparging of the present invention also will result in a reduction of the oxygen in the packaging head space on the order of 25%. The reduction of oxygen both in the citrus juice itself as well as in the packaging head space substantially improves the shelf life of the citrus juice and reduces undesirable oxidation and browning reactions during such storage which may result in the development of off-notes.

[0005] It has also been discovered that when the nitrogen sparging of the present invention is performed just preceding a pasteurization heat exchanger, the heat efficiency of the heat exchanger is increased due to the turbulence caused by the numerous small nitrogen bubbles and this turbulence reduces the energy cost of the pasteurization heat exchanger.

[0006] It has also been discovered that the nitrogen sparging of the present invention appears to remove at least some of the volatile compounds which have off-notes to result in an improvement in the flavor and/or sensory quality of the citrus juice.

[0007] In one principal aspect of the present invention, a system and method for the processing of citrus juice comprises, a supply station for supplying a quantity of the citrus juice, a packaging station for packaging the citrus juice, and a passage for communicating the citrus juice from the supply station to the packaging station. A supply of nitrogen gas is provided and a sparger is associated with the passage and connected to the supply of nitrogen gas . The sparger introduces the nitrogen gas as numerous small bubbles to the citrus juice which is being communicated through the passage from the supply station to the packaging station.

[0008] In another principal aspect of the present invention, the sparger is in the passage.

[0009] In still another principal aspect of the present invention, the sparger is a sintered metal sparger.

[0010] In still another principal aspect of the present invention, the system and method include at least two tanks for holding or transferring the citrus juice, the passage communicates citrus juice between the two tanks, and the sparger introduces the nitrogen to the citrus juice in the passage between the two tanks.

[0011] In still another principal aspect of the present invention, the system and method include a pasteurization station and the sparger introduces the nitrogen to the citrus juice just preceding the pasteurization station.

[0012] In still another principal aspect of the present invention, the sparger introduces the nitrogen to the citrus juice just preceding and/or in the packaging station.

[0013] In still another principal aspect of the present invention, at least one sparger introduces the nitrogen to the citrus juice in the passage between the two tanks, another sparger introduces the nitrogen to the passage to the pasteurization station, and still another sparger delivers the nitrogen to the citrus juice just preceding packaging.

[0014] These and other objects, features and advantages of the present invention will be more clearly understood through a consideration of the following detailed description.

Brief Description of the Drawing

[0015] In the course of this description, reference will frequently be made to the attached drawing in which:

[0016] FIG. 1 is a schematic depiction of a preferred embodiment of system of the present invention for the processing of citrus juices for packaging and which system performs the preferred embodiment of method of the present invention; and

[0017] FIG. 2 is a cross sectioned side elevation view of a conduit through which the citrus juice is communicated through the system as seen in FIG. 1 for processing, and which includes a preferred embodiment of nitrogen sparger of the present invention.

Description of The Preferred Embodiments

[0018] With particular reference to FIG. 1, a typical citrus juice system for processing the juice for packaging generally comprises a juice supply station 10, a pasteurization station 12 and a packaging station 14.

[0019] The juice supply station 10 typically has one or more tanks 16 and 18 as shown in FIG. 1 for holding a supply of citrus juice, such as raw orange juice. One of the tanks 16 and 18 instead of holding citrus juice may hold water and or other fluids which are to be blended into the juice during processing. It will be appreciated that although two tanks 16 and 18 are shown, the number of tanks in the supply station 10 may vary.

[0020] The pasteurization station 12 typically includes two heat exchangers 20 and 22. The heat exchanger 20 has the purpose of heating the citrus juice prior to packaging and to a sufficient temperature and time, e.g. about 195°F for about 5-6 seconds, to kill any bacteria that may be in the juice. Although as previously discussed in the prior vacuum procedures in which heating typically occurred which resulted in thermal degradation, that heating occurred over much longer 3-4 minute time durations. The elevated temperatures in the pasteurization process are imparted over a much shorter period which greatly minimizes the possibility of any undesirable thermal degradation of the citrus juice. However, these pasteurization times and temperatures are sufficient to insure that any undesirable bacteria are killed. After heating the citrus juice in heat exchanger 20, the juice is then immediately and rapidly cooled in heat exchanger 22 to a temperature which is sufficiently low to place it in readiness for cold packaging, e.g. about 35°F. If the juice is to be hot filled, heat exchanger 22 may be eliminated. Any one of several heat exchanger types may be employed as the heat exchangers 20 and 22, but tubular heat exchangers are generally preferred.

[0021] The packaging station 14 typically includes an aseptic tank 24 for receiving the pasteurized citrus juice and hold it under sterile conditions in readiness for packaging. When it is desired to commence packaging, a certain amount of the previously pasteurized citrus juice is communicated from the aseptic tank 24 to a filler

tank 26 from which it is metered and discharged cold to the ultimate packaging 28 in which it is to be stored and ultimately marketed. The packaging 28 may include bottles or cartons of the kind which are conventionally employed in the packaging of citrus juices.

[0022] In addition to the juice supply station 10, pasteurization station 12 and packaging station 14 as just described, a typical system for processing citrus juice for packaging will include one or more surge/transfer tanks 30 and 32 as shown in FIG. 1, as well as pumps 34, 35 and 36 and control valves 38, 39 and 40 for controlling the flow through the various conduits or passages generally 42 through which the citrus juice is to be communicated between components and stations of the processing system. Moreover, one or more bypass conduits, such as conduit 44 with control valve 46, may be provided to bypass some of the production line components when they are not needed or to permit maintenance.

[0023] The processing system thus far described is essentially conventional in the art for citrus juice processing for packaging. What is novel in the present invention and an important feature of the present invention is the discovery of the many advantages that may be realized by the sparging of the citrus juice which is being processed at one or more locations in the system with small numerous bubbles of nitrogen gas. Referring particularly to FIG. 2, the conduit 42 through which the citrus juice passes includes a sparger 48 which is coupled to a flask 50 or other suitable supply of nitrogen gas. A suitable valve 52 is preferably provided to control the flow or stop the flow of nitrogen to the sparger 48.

[0024] The sparger 48 may take any one of a number of forms including porous metals, ceramics, and the like. What is important, however, is that the sparger 48 produces a large volume of many small bubbles having a high surface area to efficiently purge the undesirable volatile compounds and dissolved oxygen from the citrus juice. Particularly preferred is a sintered metal sparger which is available from Mott Corporation, Farmington, CT.

[0025] Spargers of various lengths and widths may be employed so long as they produce the large volume of numerous small bubbles desired. Spargers of 0.5 inch

diameter and length of about 10 inches have been found to be effective. However, it will be appreciated that it is not intended to limit the invention to such diameter and lengths.

[0026] As previously mentioned the sparger 48 may be located at one or more locations in the processing system. For example, referring to FIG. 1, a sparger 48 may be located at location A just after introduction from the juice supply station 10 as the citrus juice is being communicated to surge/transfer tank 30.

[0027] A sparger 48 may also be located at location B as the citrus juice is being communicated either from the surge/transfer tank 30 to the surge/transfer tank 32, or if it is being bypassed through bypass conduit 44, as it is being communicated to the pasteurization station 12.

[0028] A sparger 48 may also be located at position C as the citrus juice is being communicated from the surge transfer tank 32 to heat exchanger 20 in pasteurization station 12.

[0029] It has been found that sparging with nitrogen at location B, if bypass through conduit 44 is used and just preceding the heat exchanger 20, or at location C if the juice is not bypassed and just before the heating heat exchanger 20 is particularly effective in creating turbulence in the citrus juice. This turbulence improves efficiency of the heat exchanger resulting in a reduction in the steam energy needs and the cost of such energy.

[0030] A sparger 48 may also be located at location D in the packaging station 14, for example, to sparge the citrus juice in filler tank 26 just prior to its introduction to the packaging 28. It has been found that nitrogen sparging at location D in particular is highly effective to reduce the percentage of oxygen in the packaging head space.

[0031] Although nitrogen sparging at any one of the locations A – D will result in a reduction in the level of dissolved oxygen in the citrus juice and removal of volatile off-note compounds, sparging at more than one location generally results in a larger reduction.

[0032] It has been found that nitrogen flow rates of between 2-10 standard cubic feet per hour (SCFH) through one or more spargers is capable of reducing dissolved oxygen levels from as much as 4-5ppm in the citrus juice to less than 0.03ppm, and to even as little as 0.002ppm. This is in contrast to levels of about 0.5ppm which were

obtained using the prior vacuum procedures. Generally, the longer the nitrogen is retained in the juice after sparging, the lower the dissolved oxygen levels will be. Nitrogen retention times of between 6-35 seconds have been found to be effective. Moreover, these significant reductions in dissolved oxygen levels can be achieved at temperatures of as low as 35°F without the need to expose the citrus juice to thermal treatment at considerable temperatures and for periods of time as were needed in the prior vacuum procedures to attain levels only as low as 0.5ppm. In addition oxygen levels in the packaging head space can be reduced by as much as 25% using the nitrogen sparging of the present invention. Further, sensory analysis panels which have analyzed orange juice which has been processed in accordance with the present invention have found a statistically significant improvement in the desirable flavor quality of expressed orange oil.

[0033] It will be understood that the preferred embodiments of the present invention which have been described are merely illustrative of the principles of the present invention. Numerous modifications may be made by those skilled in the art without departing from the true spirit and scope of the invention.

We Claim

1. A system for the processing of citrus juice comprising,
a supply station for supplying a quantity of the citrus juice;
a packaging station for packaging the citrus juice;
a passage for communicating the citrus juice from said supply station to said packaging station;
a supply of nitrogen gas; and
a sparger associated with said passage and connected to said supply of nitrogen gas, said sparger introducing the nitrogen gas as numerous small bubbles to the citrus juice which is being communicated through said passage from said supply station to said packaging station.

2. The system of claim 1, wherein said sparger is in said passage.

3. The system of claim 1, wherein said sparger is a sintered metal sparger.

4. The system of claim 1, wherein said system includes at least two tanks for holding or transferring the citrus juice, said passage communicates the citrus juice between said two tanks, and said sparger introduces the nitrogen to the citrus juice in the passage between said two tanks.

5. The system of claim 1, wherein said system includes a pasteurization station and said sparger introduces the nitrogen to the citrus juice just preceding said pasteurization station.

6. The system of claim 1, wherein said sparger introduces the nitrogen to the citrus juice just preceding and/or in said packaging station.

7. The system of claim 2, wherein said system includes at least two tanks for holding or transferring the citrus juice, and a pasteurization station, said passage

communicates the citrus juice between said two tanks, said pasteurization station and said packaging station, and at least one said sparger introduces the nitrogen to the citrus juice in the passage between at least one of said two tanks, said pasteurization station and/or said packaging station.

8. The system of claim 7, wherein at least one said sparger introduces the nitrogen to the citrus juice in the passage between said two tanks, another said sparger introduces the nitrogen to the passage to said pasteurization station, and still another said sparger delivers the nitrogen to said packaging station.

9. A method of processing citrus juice containing substantial levels of dissolved oxygen comprising sparging the citrus juice with numerous small bubbles of gaseous nitrogen.

10. The method of claim 9, wherein the sparger is a sintered metal sparger.

11. The method of claim 9, wherein the sparging is of citrus juice which is being communicated between two tanks.

12. The method of claim 9, including pasteurizing the citrus juice, and the sparging is performed just preceding the pasteurization.

13. The method of claim 9, wherein the sparging is performed during at least one of while said citrus juice is being communicated between two tanks, just preceding pasteurization and/or packaging.

14. The method of claim 13, wherein the sparging is performed at each of the last mentioned locations.

ABSTRACT

A system and method are disclosed for the processing of a citrus juice for packaging in which the juice is sparged with numerous small bubbles of nitrogen gas at one or more locations during the processing to reduce the levels of dissolved oxygen in the juice and the levels of oxygen in the packaging head space to improve the taste and sensory qualities of the citrus juice and/or to introduce turbulence to the juice.

FIG. 1

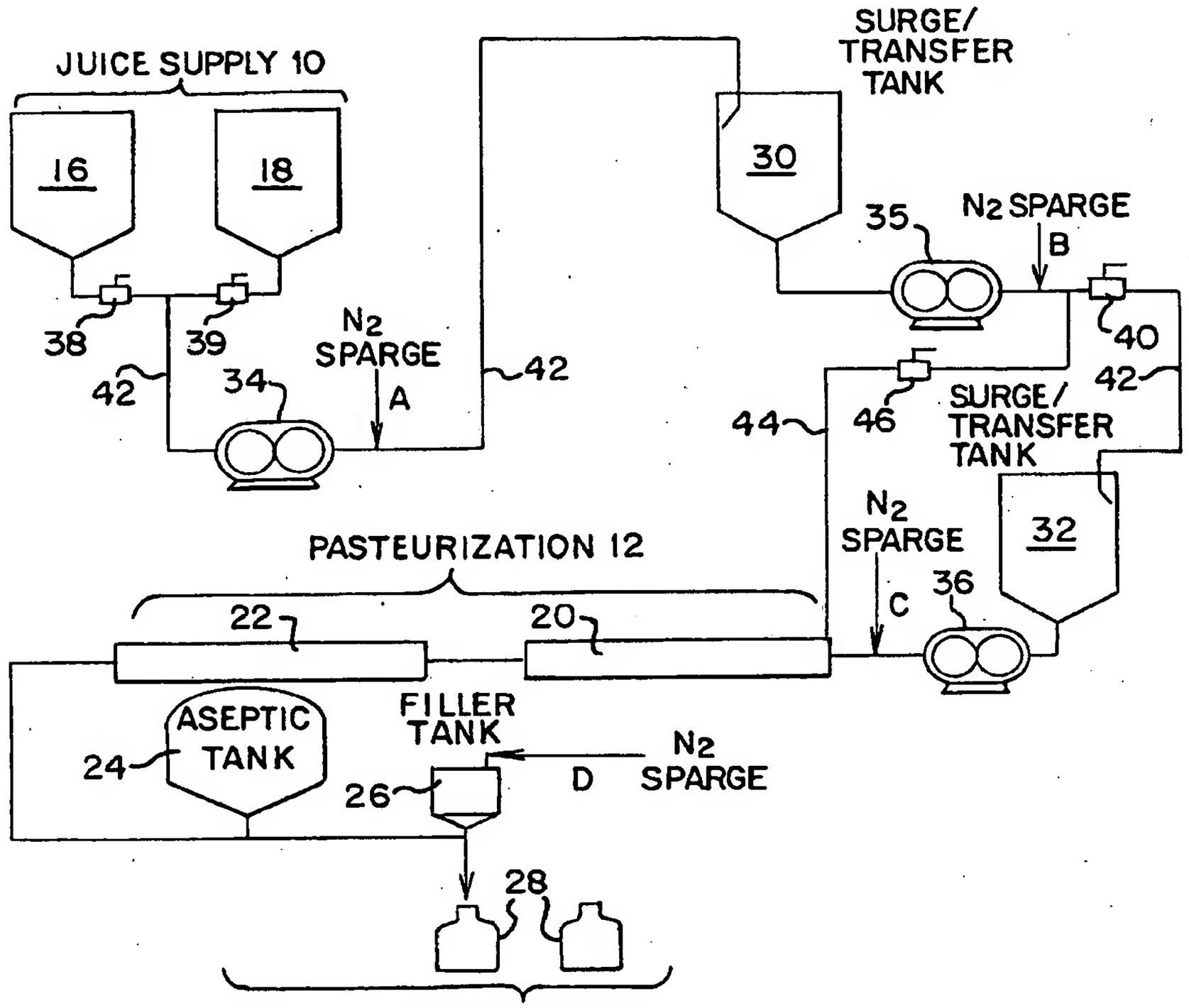
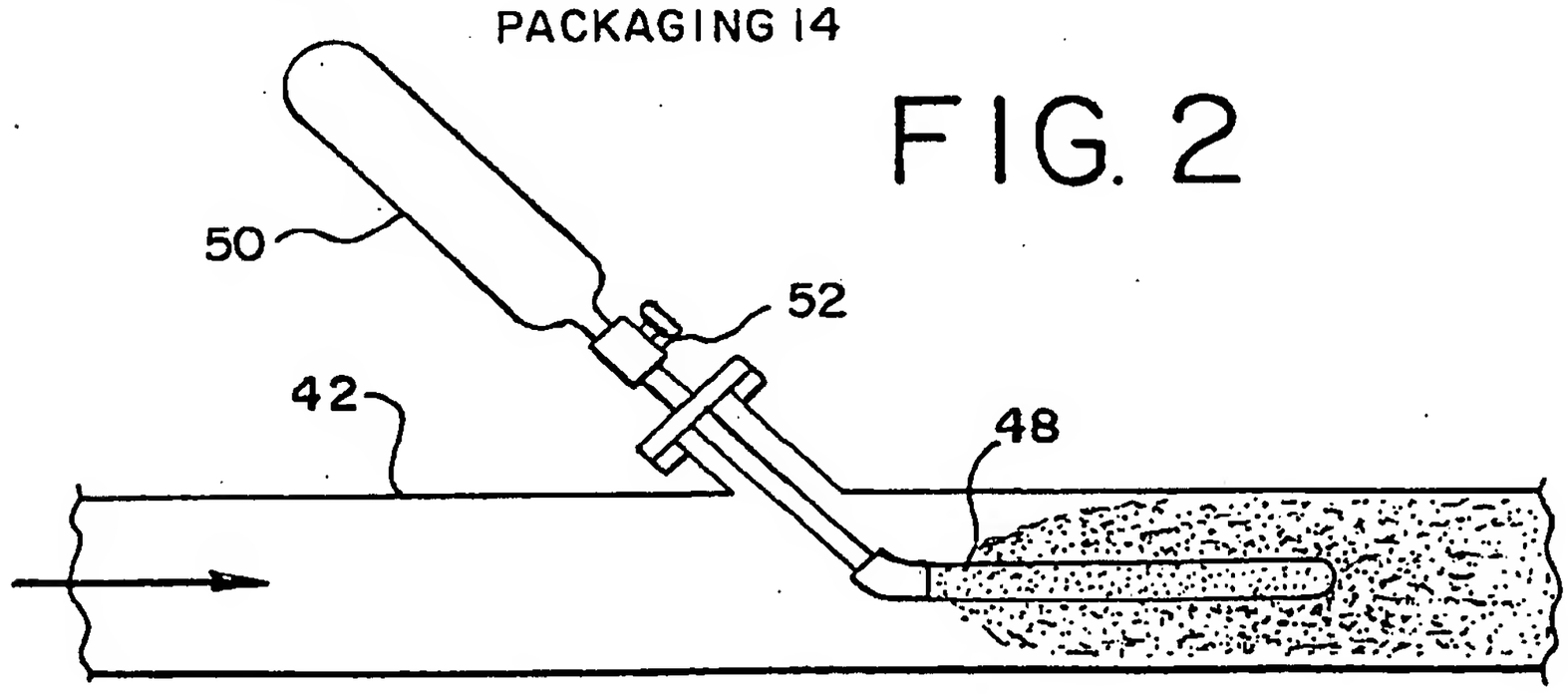

JUICE SUPPLY 10
16
18
38
39
42
42
34
N2 SPARGE
A
42
SURGE/
TRANSFER
TANK
30
35
N2 SPARGE
B
40
42
44
46
SURGE/
TRANSFER
TANK
32
N2
SPARGE
C
36
PASTEURIZATION 12
22
20
ASEPTIC
TANK
24
FILLER
TANK
26
N2
D
SPARGE
28
PACKAGING 14

FIG. 2


50
52
42
48